Haaga-Helia
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Use Case and Platform Potential Study for Research & Development Project CITYZER

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Abstract

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CITYZER is a three-year Tekes-funded research and development project that targets to develop new digital services and products using weather and air quality data and forecasting models, for global markets.

This thesis serves the project and the research objectives to form a theoretical understanding of how platform ecosystems work, and to evaluate if CITYZER could become a platform ecosystem and what kind of platform ecosystem. Another objective was to collect use cases from relevant industry segments in Finland for the project to develop further.

The research consists of a theoretical part that was conducted as a desk study of earlier researches, literature, project documentation and other secondary data sources, and semi-structured use case interviews which were carried out in companies from selected industries during spring 2017. Additionally, an interview of a start-up data analytics company was done similarly as a semi-structured interview.

The interviews produced a lot of valuable information and ideas about CITYZER potential in business-to-business market from industries in which weather conditions play a significant role.

As a result from this research, there are no such things that would prevent CITYZER from becoming a platform ecosystem. The other options are to start with conventional service or product business or operating as a hybrid, having both own service production and offering the open data platform for developers to use. In any case establishing the business model requires throughout consideration of the options and decision making.

The most important things are to realize the differences and requirements of the different business models and determining the CITYZER partners' roles 1) for the rest of the project when the demo service goes live and 2) after the project when the value and attraction of CITYZER is really tested.

Keywords
CITYZER, Platform Ecosystem, Weather Data, Use Case

Terms and abbreviations

ERP	Enterprise Resource Planning. The integrated management of core business processes, often in real-time and mediated by software and technology.
Haaga-Helia	Haaga-Helia University of Applied Sciences
FMI	Finnish Meteorological Institute
Ro-ro	Vessels designed to carry wheeled cargo, like trucks trailers and cars, and that are driven on and off the ship on their own wheels or using a platform vehicle.
Tekes	Tekes, Finnish Funding Agency for Innovation

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1 Introduction

This thesis serves a three-year project called CITYZER that is a research and development project involving participants from various companies and universities (CITYZER 2017a).

> The CITYZER project develops new digital services and products to support decision making processes related to weather and air quality in cities. This includes, e.g., early warnings and forecasts (0-24 h), which allow for avoiding weather-related accidents, mitigate human distress and costs from weather-related damage and bad air quality, and generally improve the resilience and safety of the society. (CITYZER 2017b)

The project is divided into several work packages (WP) concentrating to different angles of this research and development work and this thesis is part of WP3 that focuses on localization, user profiling and business models (CITYZER 2017a).

The term “CITYZER” is used in this thesis to refer to the outcome of the project; the (platform) ecosystem, product or service that produces the business value, as the commercial name has not yet been determined. Haaga-Helia University of Applied Sciences (later: Haaga-Helia) has participated in CITYZER research work since the beginning of the project.

1.1 Scope

Scope of the thesis is first to understand if CITYZER can become a platform ecosystem and what are the alternative platform models and second, contribute on the use case collection for the project further use. This research concentrates primarily in the use of weather data and forecasting as those are more relevant and topical issues than air quality for the interviewed industries, and in Finland where the interviews were carried out.

The research was done by accumulating a theoretical understanding on the topic, using the already existing secondary data and use cases from the CITYZER project and by collecting potential, new use cases from interviews carried out during spring 2017.

CITYZER project’s primary scope and interest is in business-to-business customers, not consumers as that market is already over-saturated (Laiho 20 February 2017). Thus, the focus in this research is in business-to-business though there are references to the consumer services when that has been seen necessary or beneficial.

The interviewees were selected from companies whose business is dependent on or impacted by weather conditions.

1.2 Objectives and research questions

The objectives were to 1) understand how platform ecosystems work and 2) collect use cases from relevant industry segments in Finland for the project to develop further and 3) evaluate if CITYZER could become a platform ecosystem and what kind of platform ecosystem.

The primary research questions were:

- What are the differences between platform ecosystems and traditional products or services?
- What kind of use cases and user groups (i.e. platform sides) CITYZER is expected to serve?
- Can CITYZER become a weather and air quality platform ecosystem and what are the requirements for becoming one?

1.3 Structure of the thesis

The structure of the thesis is following: after introducing the thesis background, objectives and the project in first two chapters, Chapters 3 and 4 explain how the platform ecosystems work and how they differ from product and service business, followed by Chapter 5 about current competition and market in the weather forecasting services. The research methods can be found in Chapter 6 and the use cases created based on the interviews are in Chapter 7. The thesis seeks answers to the research questions and objectives by using all information from the secondary data and interviews in the results and analysis in the Chapter 8. The last chapters are about conclusions and discussion about the whole research process and results in general. The confidential parts of the research are noted in the text and are not available in the public version of this thesis.

The thesis structure is presented in Figure 1. Thesis schedule and main activities in chronological order can be found in Appendix 4.

Figure 1 The thesis structure

2 CITYZER

2.1 The project

CITYZER is a three-year (2016-2018) research and development project that aims to develop new digital services and solutions to support decision making based on weather and air quality. These might for instance be weather and bad air quality warning services that allow preventive and protective actions and thus improve the resilience and safety in the society, especially in areas that are severely impacted by extreme weather conditions and poor air quality. CITYZER targets to produce a set of services for several customer segments, such as governmental and municipal authorities, city and real estate decision makers and citizens. The services and products will be piloted in Helsinki area and the final outcomes from the CITYZER project are the ones with great commercial and export potential that will be ensured through cooperation with the relevant market partner teams which provide the necessary insight to those market areas and conditions already during the project. (CITYZER 2017a)

Business decision making is a process where first the situation is analysed by trying to understand the characteristics of the circumstances and environment, followed by evaluation of options and finally, when the analysis is done, a certain course of action is chosen and acted on. Later the results of the actions and how the situation has changed by the internal actions and external influences can be seen and evaluated. (Bhatia 2012, 140.) CITYZER targets to support companies in this decision-making process regarding weather and air quality circumstances.

2.2 Weather forecasting

Forecasters predict the weather on different timeframes from 0 hours up to several weeks. Nowcasting i.e. very short-range forecasting refers to nearest 0-12 hours' weather forecast, short-range forecast to 12-72 hours' forecasts, medium-range forecast covers 3-7 days and extended forecast the second week ahead. In addition to forecasting, the weather forecasters use hindcasting that is producing a "forecast" based on history data. Hindcasting helps to analyse the forecast used for instance in occurrence of hurricanes and produce better forecast models for the future. Re-analysis is a mix of hindcasting and modelling past weather and is used to find out what the weather was in an unmonitored location in certain time and reconstruct the weather conditions afterwards. The value and accuracy of weather forecasts has constantly improved and today a seven-day forecast is almost as accurate as a three-day forecast in early 1980's. (World Bank 2008, xii-xviii)

CITYZER focuses on the early warning mechanisms and on the very-short and short-range forecasts between 0-24 hours (CITYZER 2017a).

2.3 CITYZER partners

CITYZER ecosystem consists of weather radars, air quality sensors and other observational systems that feed the data to the now- and forecasting model and it is prepared to accommodate all needed detector networks, make the collected data available through the servers and provide a platform for applications utilizing the information. Implementation of this solution requires close collaboration between meteorological, air quality, system impact and ICT communities and the project partners. CITYZER project partners represent the necessary areas of expertise:

- Vaisala (weather observation instrumentation and products),
- Finnish Meteorological Institute, FMI (scientific research on meteorological & air quality products and implementation),
- Pegasor Ltd (support for air quality instrumentation).
- Sasken (mobile solutions),
- Emtele Ltd (Portable IoT ICT Service Operation Center/Environment and remote intelligent cabinet for sensor network-GW and connections),
- Helsingin Seudun Ympäristöpalvelut, HSY (environmental services in Helsinki metropolitan area),
- Haaga-Helia University of Applied Sciences (business modelling and digital services),
- Tampere University of Technology, TUT (definition of and scientific research on air quality products),

Additionally, CLIC Innovation Ltd is subcontracted for arranging cooperation with international partners and project information dissemination, composing the consortium agreement and supporting other legal issues. (CITYZER 2017b) The CITYZER ecosystem is presented in Appendix 1.

The project consists of five work packages (WP) of which WP1 and WP2 build the technical basis by establishing the observational and forecasting systems on which the user-tailored environmental services developed in WP4 will be based on. The two more work packages cover the non-technical work where WP5 is responsible for project management and concept and WP3 focuses on international aspects; customer profiling, market analyses and business modelling. (CITYZER 2017c) This thesis is part of WP3 business model research.

2.4 CITYZER platform layers and user groups

In this thesis, the core term ‘platform’ is used in following way: a platform is a construction that offers others a place to use or build upon and do business with it. A simplistic example of a platform is a market place that attracts both sellers and buyers to meet there and do business with each other. In software business, that is the focus in this thesis, a platform is such technology that can serve as a ground for applications and their developers.

CITYZER consists of several layers that produce value for the solution. The existing and potential key assets, the layers, of CITYZER are:

- The weather and air quality data
- Analytics e.g. weather forecast models and air quality predictions
- Business/Industry Services (e.g. tailor-made applications that can be integrated to other systems or a software as a service that provides necessary features for business users)
- Applications based on the data or all previous ones

The potential user groups are: 1) application developers that might want to access direct data and/or use the analytics, 2) business system integrations that access either data or analytics, 3) business users that are the end-users of the business/industry specific services developed on top of the data and analytics and 4) consumers/citizens that use the applications that can be browser-based websites or mobile applications. The layers and users are presented in Figure 2.

The access to the data and/or analytics layer could be in theory provided for free (an open platform) or restricted to using licences or periodical or use-based fees, or combination of those. For instance, some data and parts of the platform could be accessed without any charges and some not or the commission is charged from the revenue that application developers make using the platform.

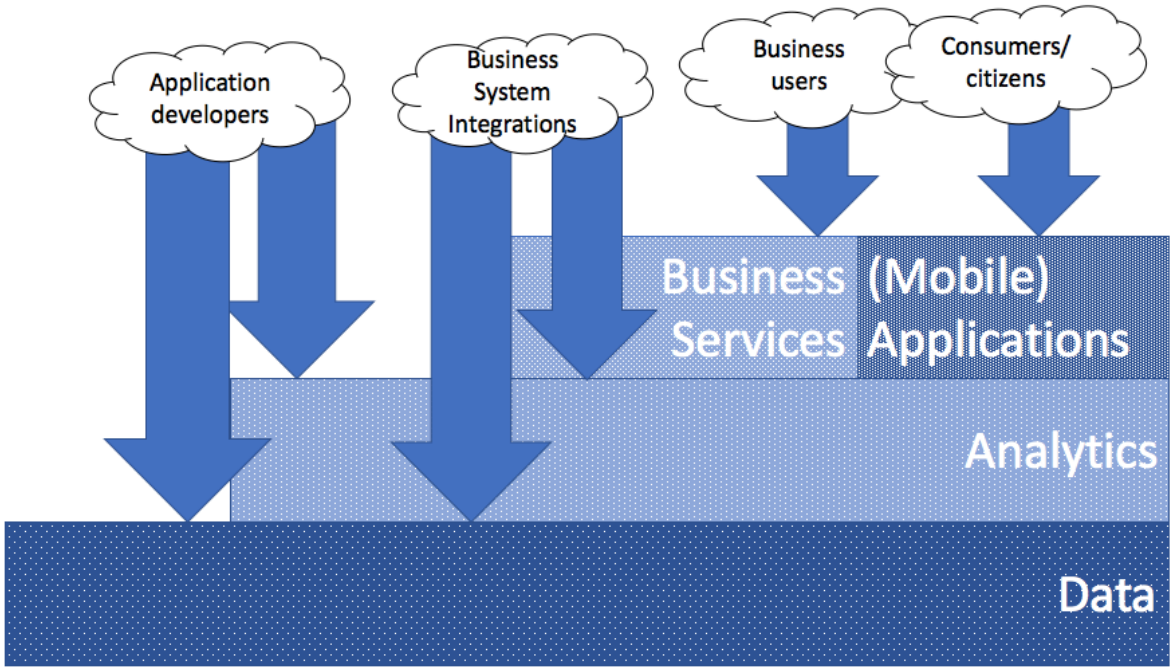

Figure 2 CITYZER Layers and User Groups

3 Platform ecosystems

Platform Ecosystem is a composition of externally produced complements that enlarge the capabilities of the platform. A software platform is an expandable software product or service that serves as a foundation for independent, external parties to build these complementary products and services (apps) that interoperate through the platform interfaces. The entirety of the platform and the apps that interoperate with it, is the platform ecosystem. A true platform serves at least two distinct user groups, such as app developers and the users and therefore should not be mixed with conventional one-sided products or services that have different rules and principles. (Tiwana 2014, 20)

A platform ecosystem is the entirety consisting of the platform, applications built on top of or using it, interfaces enabling the interactions within the platform and the users of the platform and apps, and their business activities. In other words, platform enables the mutually beneficial relationships – often customerships – between and amongst the distinct platform user groups like the app developers and app users, whereas in traditional businesses those are built between the product or service provider and customers.

Figure 3 illustrates the difference between relationships in product or service business and platforms. It is notable that necessarily not all user groups within a platform ecosystem need to have a relationship or impact to each other though they have that opportunity. The value of the relationships, and importance and volume of other user groups for each other depends on the purpose and use of the app: as an example, a mobile application for public traffic connection generates little if at all interaction between end-users whereas social media apps are fully dependent on that.

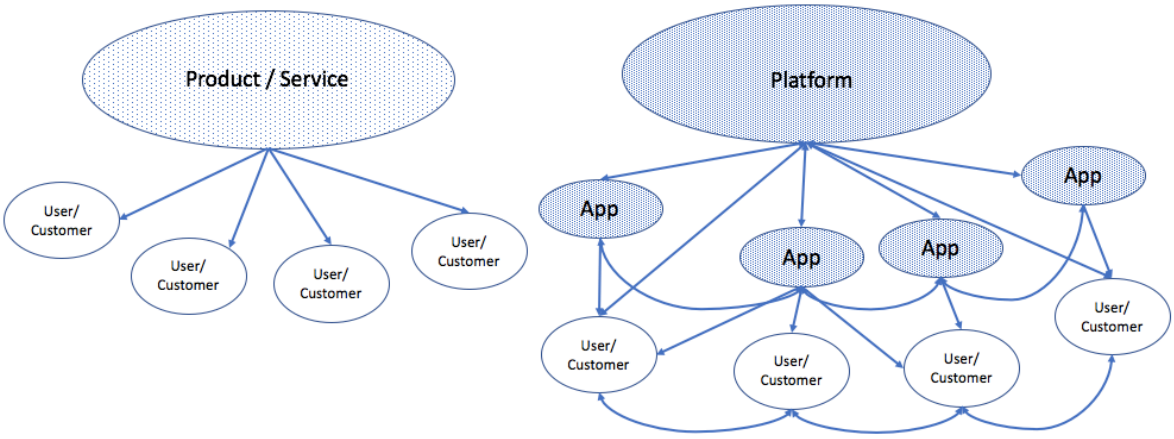

Figure 3 Relationships of platform ecosystem and traditional product/service

3.1 Platform architecture

Platform architectures consist of 1) a set of components that are stable and 2) a complementary set of components that can and are encouraged to vary and the combination of the stability and variety is managed via 3) versatile interfaces that govern the interactions of components. Applying platform architectures is useful when a complex, underlying system needs to adapt changing needs and technologies. Complex systems contain various components that must work together to produce the whole functionality, but tight integrations might cause stiffness. Platform architecture instead allows the evolution also for core components, only the interfaces need to stay stable. This way the whole platform system becomes evolvable. (Baldwin & Woodard 2009. 35-41.)

The fundamental architectural feature of a platform is that certain components are stable and others are allowed change or alternate during the whole lifecycle of the platform. This means that the longest living core component sets certain constrains or design rules that establish the government among all platform components. A platform architecture is formed of these core components and variable components and by promoting the reuse of core components the costs of variety and innovation can be reduced as the whole system needs not to be built from scratch when developing new products. This way the whole platform becomes evolvable and can be considered as low-cost product without compromising its identity or design continuity. (Baldwin & Woodard 2009. 23-24.)

3.2 Core elements of a platform ecosystem

Platform ecosystems consist of: 1) a platform that is the codebase of the software based system that provides the core functionality for applications to interoperate with and the interfaces for that 2) apps, often called modules, extensions, plug-ins or add-ons, which are the software subsystems that connect to the platform to add functionality to it 3) the ecosystem that is the entirety of the platform and apps 4) interfaces that describe how the interaction and exchange of information between the platform and apps takes place (protocols) 5) the architecture that is a conceptual blueprint that describes how the ecosystem is partitioned between stable platform and variable apps and the binding design rules on both. (Tiwana 2014, 7) These elements are illustrated in Figure 4.

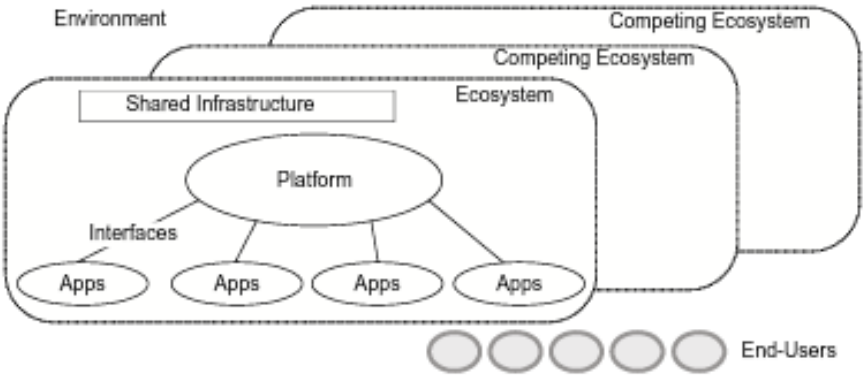

Figure 4 Elements of a platform ecosystem (Tiwana 2014, 7)

Evans and Schmalensee (2007, in Tiwana 2014, 9) have defined that common nominator of all platforms is that they facilitate interactions between two distinct groups (two sides) that want to interact with and need each other. Examples of well-known platforms are iOS, Android, Facebook and Chrome. Almost all successful platform ecosystems have started as standalone products serving only end-users first and have transformed to platforms over time when the second side, the developers, was added. The multisidedness is such an essential quality of a platform that one-sided platforms are not considered as true platforms. (Tiwana 2014, 9)

However, the decision of how many sides to begin with is difficult for any start-up platform. Starting with many might look an appealing option however comes with certain risks: first, attempts to attract many sides simultaneously might spread the platform owner thin and reduce dedication to solve fundamental issues secondly it can trigger more negative network effects instead positive ones. Typically, it is easier to start with few or only one side in the beginning. (Tiwana 2014, 33)

Birkstedt (7 March 2017) also brought up that for a start-up company an appropriate approach is to go into market with minimum viable product to receive user experiences and learn from that to develop the product further and this can be done also in cooperation with selected customers.

3.3 Multisided platforms and network effects

Platform ecosystems are much impacted by network effects. Network effect or network externalities refer to the added value that each additional member brings to every other user when enlarging the network (Katz & Shapiro 1994, 94). The multi-sided platforms generate added value by coordinating the multiple groups of these members (agents) and,

specifically, ensuring that there is sufficient number of members of each type to make participation worthwhile for all types (Evans & Schmalensee 2013, 2-3).

The network effect is evident e.g. in social media systems that have no value for any user alone but each user adds the value and potential of the system. The network effect can bring different benefits, such as better maintenance and support availability due to larger number of users. Regarding multisided platforms, the network effects take place in each side and between sides (Figure 5).

The end-users benefit from additional end-users and developers adding new developers. A cross-side positive network effect is, that the increase of users appeal more developers to join the developer community and a well-designed platform should consciously harness this phenomenon. Network effect can also be negative in cases where adding new participants to sides decreases the value of appeal on the same or other side. (Tiwana 2014, 35) This can be the case e.g. in over-saturated markets or when the availability or capability of the product or service is insufficient.

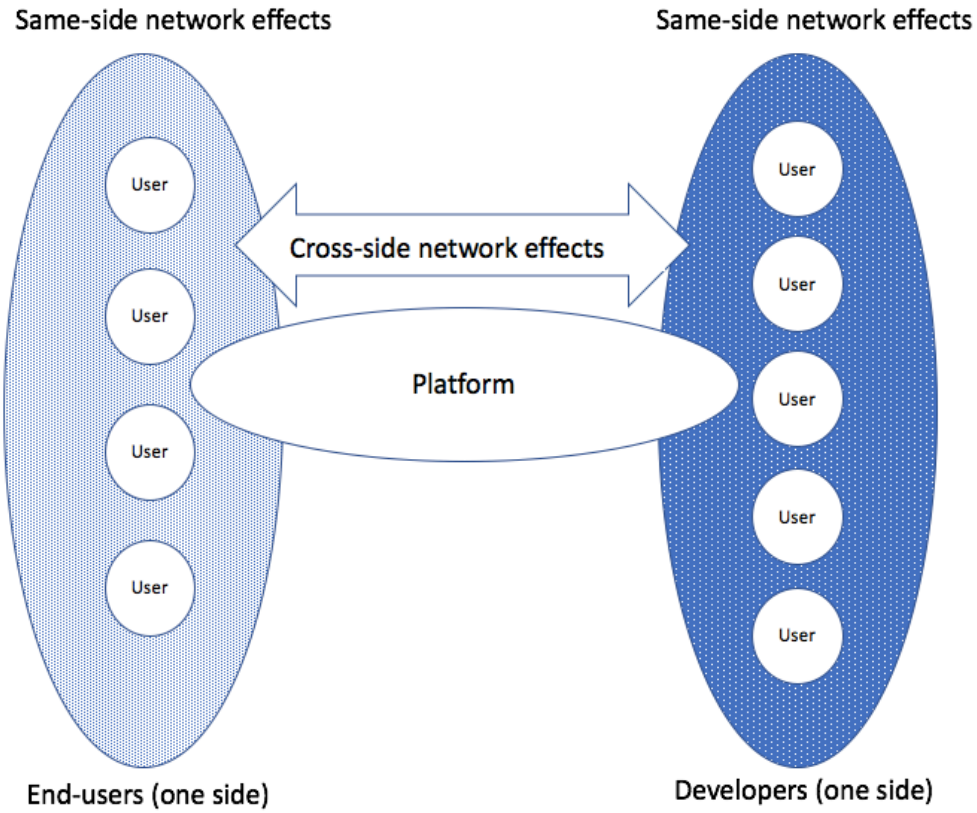

Figure 5. Same-side and cross-side network effects

Evans & Schmalensee (2013, 5-6) explain the functions and economies of a multi-sided platform using an example of an online restaurant reservation system, OnTable, that has several features of multi-sided platforms:

- It presents two sorts of network externalities i.e. network effects; both consumers and the restaurants benefit from the use of the system and the system becomes more valuable to users the more restaurants become members of it.
- OnTable facilitates the valuable interactions between two sides
- The price structure is common for multi-sided platforms; the restaurants pay a fee for the software use when they become part of the platform plus they pay a fee for usage (amount of reservations). The other side, consumers, need not to pay fees for usage.

Today mobile application developers benefit a lot of freely available data, such as location or public transportation data, that can be used as basis for variety of mobile solutions. Recent examples in Helsinki area are a mobile solution that presents visually the availability and capability (using frequency and operating hours) of the public transportation for any location in Helsinki centre and another solution that calculates the potential customer base (number of citizens) for a selected business space. For the first mentioned, the app developer made over 30 billion route searches to generate the map. (Helsingin Sanomat 2017, 14)

3.4 Platform ecosystems in software business

Platform-based software ecosystems are becoming dominant models in the industry. The five drivers behind this progress from products and services to platform-based competition are:

- Deepening specialization in all industries that has led to complex aggregation of firms specialized narrow and deep partnering with each other.
- Packetization i.e. digitization of something that was not earlier digitized.
- Software embedding which means that software applications are harnessed to routine business processes and activities regardless the industry.
- The internet of things.
  Ubiquity, which means the abundance of cheaper and faster wireless data networks. (Tiwana 2014, 4-17)

Therefore, studying if CITYZER could form a platform ecosystem instead of becoming solely a data provider or a traditional product or service producer is relevant.

When a new technology solution enters the market, many companies try to come into the competition with an alternative design. At some point one of these competing designs becomes the dominant one and widely accepted winning standard and the competitors need to adjust their design to meet the norms of users' needs and expectations. The dominant design might not be an exceptional solution and might involve compromises to appeal big volumes of users. (Tiwana 2014, 24)

Tiwana (2014, 23-25) identifies the diffusion curve as one of the core concepts i.e. fundamental ideas of platform ecosystems. Rogers' (2003 in Hoffman 2007, 37-50) model of diffusion of innovations describes the technology lifecycle and users impact and behaviour during that: an innovation is communicated through certain channels over time among the members of a social system. The users of a technology can be categorized to: innovators, early adopters, early majority, late majority and laggards and the distribution of adopters tend to follow S-shaped curve over time where the midpoint is in between early and late majorities. The whole table of core concepts is in Appendix 5.

Many products have little or no value alone but become meaningful when combine with others and often the components bought for a single system are spread over time which means that rational consumers start to form certain expectations towards the products. This leads to use of certain compatible systems as switching the system becomes costly. (Katz & Shapiro 1994, 93-94.) A typical example of this sort of ecosystem is iOS that has gained user loyalty regarding both the system and the product (brand), unlike Android that can be used with different competing products.

The uniqueness of CITYZER technology, value for the customer or business model is not yet clarified. Many weather companies produce already services for both different industries and data interfaces to app developers, thus what is the differentiator or added value in CITYZER that attracts users, needs to be identified.

4 Platform business vs. product or service businesses

Platforms connect groups of users in two distant sides of networks. Platforms provide the ground for the infrastructure, design principles and rules that help the two transactions between the sides. Platforms can take form of physical products, e.g. in payment business consumer's credit card and agent's authorization terminal, services like web shops or places like shopping malls. Platform business is not a new phenomenon. For instance, energy companies and car manufacturers have brought together drivers and fuel stations in a mature network, and yellow pages have linked consumers and advertisers already for decades. However, the rise of technologies has accelerated the platform business in recent years; new platforms have been created and traditional businesses have been transformed into platforms. (Eisenmann, Parker & Alstyne 2006). Figure 5 lists examples of platforms in different industries and helps to understand the phenomenon.

NETWORKED MARKET	SIDE 1	SIDE 2	PLATFORM PROVIDERS
			Rival Providers of Proprietary Platforms
PC operating systems	Consumers	Application developers*	Windows, Macintosh
Online recruitment	Job seekers*	Employers	Monster, CareerBuilder
Miami Yellow Pages	Consumers*	Advertisers	BellSouth, Verizon
Web search	Searchers*	Advertisers	Google, Yahoo
HMOs	Patients*	Doctors	Kaiser, WellPoint
Video games	Players*	Developers	PlayStation, Xbox
Minneapolis shopping malls	Shoppers*	Retailers	Mall of America, Southdale Center
			Rival Providers of Shared Platforms
Linux application servers	Enterprises	Application developers	IBM, Hewlett-Packard, Dell
Wi-Fi equipment	Laptop users	Access points	Linksys, Cisco, Dell
DVD	Consumers	Studios	Sony, Toshiba, Samsung
Phoenix Realtors Association	Home buyers*	Home sellers	100+ real estate brokerage firms
Gasoline-powered engines	Auto owners	Fueling stations	GM, Toyota, Exxon, Shell
Universal Product Code	Product suppliers	Retailers	NCR, Symbol Technologies

Figure 6 Examples of Platforms in Different Industries (Eisenmann, Parker & Alstyne 2006)

One well known and successful example of a multisided platform in technology business is Apple's iPhone and Appstore. IPhone is a result of the evolution of iPod that was originally Apple's standalone music player device launched in 2001. IPod users could save their own cd's and download music from the music from internet thus at that time iPod served users as a technology platform as it could utilize music from various sources. In 2003 Apple launched their own iTunes Music Store that at time offered a unique and easy way to purchase digital music and this was the first step towards multisided platform – a

place where music producers and music consumers meet and create meaningful relationships. In 2008 following the release of iPhone, Apple introduced the Appstore, that allows the users to buy and download mobile apps to their iPhones (and other iOS operated devices) and app developers to develop and get their apps sold via Appstore producing revenue as royalties to Apple. (Osterwalder and Pigneur 2010, 62-63)

4.1 Key differences of platform business

Platform businesses differ from traditional product and service businesses in three distinctive ways: the market potential, structure and management style. At first, key difference in the expanded market potential for platforms is that they are multisided having diverse customer potential unlike majority of products and services. The multisidedness offers both platform owner and app developers potential for economies of scale that highly exceed the opportunities of products or services. Secondly, the structural differences are significant; while in product and service businesses the firm carries the risks and ownership and is the dominant innovator, in platform businesses these are spread between the platform sides and the owner. The multisidedness causes different cost and pricing principles: regarding platforms the high fixed cost is assigned to platform owner, low fix cost to app developers and variable costs to both sides and the pricing model is asymmetric across two sides. (Tiwana 2014, 49-51.)

Asymmetria in pricing means, that the platform owner makes money with one side and the other side can use it for free, with compensated or even negative price. It is not always evident which platform side – if either –should be subsidized and which should be charged (Eisenmann, Parker & Alstyne 2006).

> "The subsidized side of the platform can often make up the losses in the form of increased profits from the other side. For example, Amazon Kindle and gaming console developers (e.g., Nintendo, Sony Playstation, and Microsoft Xbox) subsidize end-users. In contrast, mobile computing platform owners such as Apple, Google, and Blackberry subsidize app developers." (Tiwana 2014, 127)

Finally, the management style for platforms needs to be different due to the diversity of the platform participants. Platform owner needs to allow app developers autonomy to innovate without compromising the ecosystem wide integrations. Critical success factor is the ability to orchestrate rather than manage, the innovation mode is more emergent than planned and the challenge is to attract both platform side instead customers. (Tiwana 2014, 51-52.)

Though the platform ecosystem model looks flexible and versatile compared to traditional firm-driven product or service businesses, and the organizational boundaries in platforms tend to become blurred, the platform owner as an orchestrator is necessary so that the decisions on the structural and management model can be made. Tiwana (2014, 55) points out that most successful platforms have started as standalone products, services or one-sided platforms and evolved to multisided platforms and vice-versa the most unsuccessful platforms that never became famous started as platforms.

The major challenge for start-up platforms is to attract two distant sides simultaneously and the safest approach is to get one side first onboard by offering an attractive and valuable product or service and later evolve to a multisided platform. For CITYZER, understanding the difference between platform ecosystem and conventional service business is essential as different business models require different management and governance styles, and they target different market segments and user groups. The decision of the model needs to be made and agreed within the consortium.

4.2 Transforming to a platform business

Business model describes how the organization aims to create, deliver and capture value. The business model needs to be well thought, conscious and rational decision and in regards of partnerships and consortiums like CITYZER it plays even a more significant role. Laiho (24 April 2017) confirmed, that a workshop with CITYZER project group discussing the business model using the business model canvas is planned to be held in autumn 2017.

Any start-up, new business or when changing the business model there is a need to identify the structures and elements of the business. For one-sided, traditional product or service business it is more straightforward to identify these nine building blocks than for platform businesses. The Business Model Canvas visualizes these elements and the differences between the business models.

4.2.1 Business model canvas

Osterwalder and Pigneur (2010, 19-20) have created a concept of business model canvas that is a useful, visual tool to describe the business model and facilitate the discussion while creating the business model in any organization.

Their business model put in a canvas format consists of nine blocks that together form the logic of how the company aims to make money:

- Key Partners
- Key Activities
- Key Resources
- Value Propositions
- Customer Relationships
- Channels
- Customer Segments
- Cost Structure
- Revenue Streams

The canvas is presented in the Figure 7.

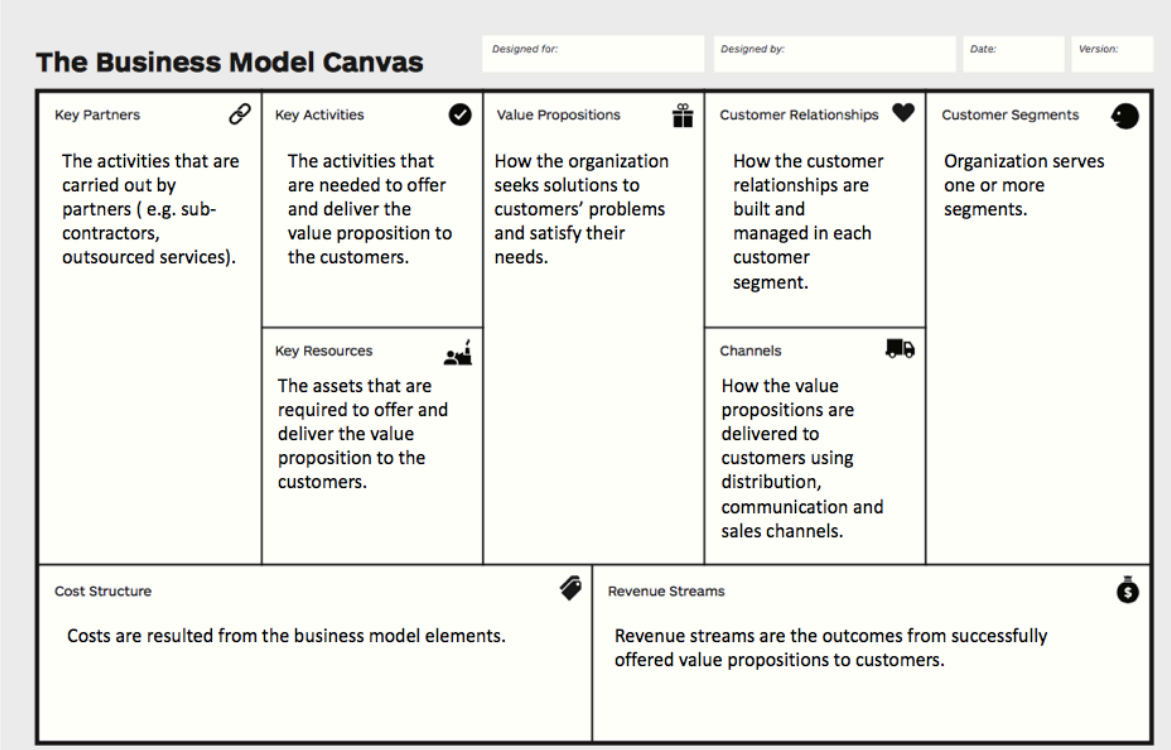

Figure 7 Business Model Canvas (Osterwalder & Pigneur 2010)

Osterwalder & Pigneur (2010, 54-55) explain the transformation from a traditional model to a two-sided platform using an example of a book publishing company. Earlier the company concentrated selectively on market-worthy works and targeted best-sellers. The money-making logic was product based; the readers were the customers and retail stores were channels to markets.

Then the business was transformed to provide the authors the tools to publish their books and the business logic changed drastically: the authors are the customers, the revenue consists of sales commissions and service fees and there's no need for separate sales channels as the business is managed online, in lulu.com. Lulu.com became a multi-sided

platform bringing together thousands of authors and readers in a same platform. Figures 8 and 9 illustrate the fundamental, strategic change in the business model from conventional product orientated business to a multi-sided platform.

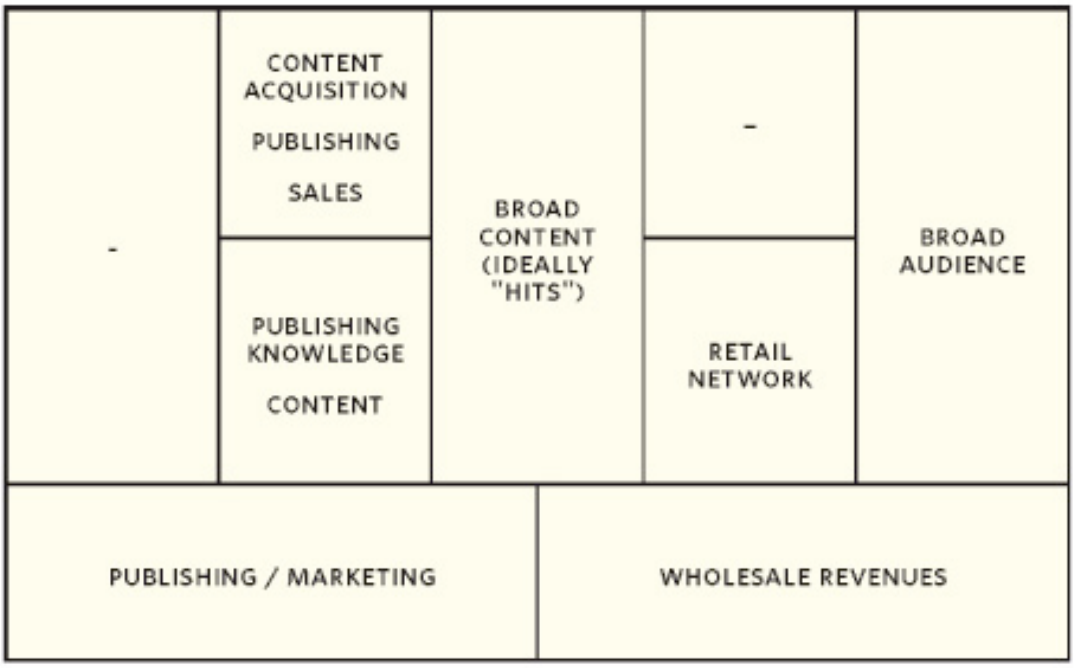

Figure 8 Book Publisher's old business model (Osterwalder & Pigneut, 2010)

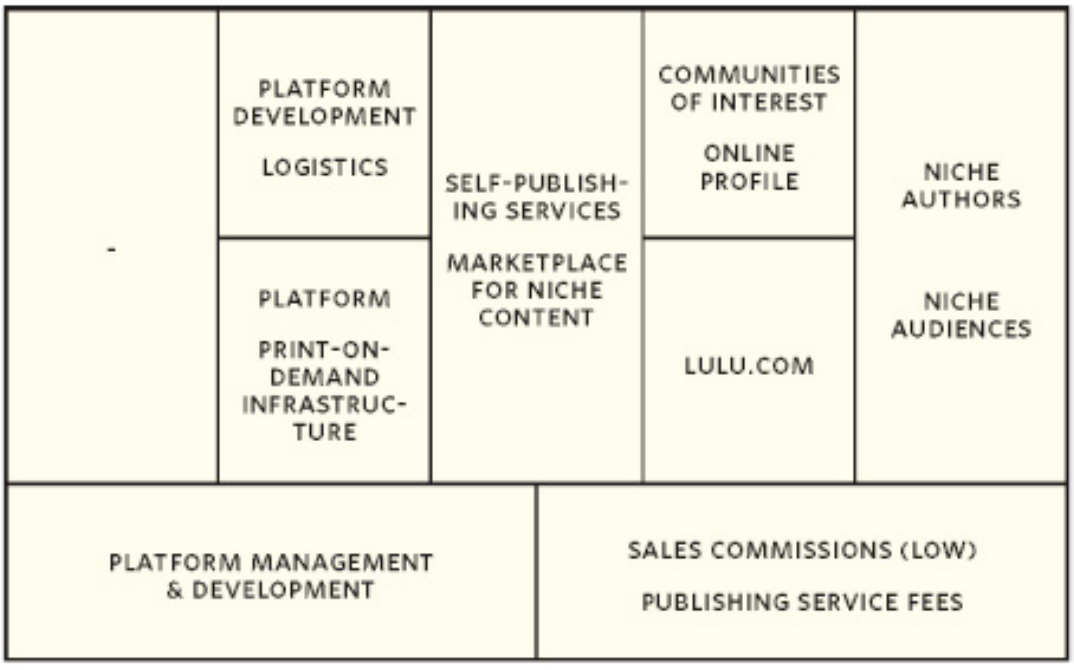

Figure 9 Book Publisher's new business model (Osterwalder & Pigneut, 2010)

4.2.2 Challenges when establishing multi-company digital platforms

Castren, Kortelainen & Seppälä (2016) researched the transformation capabilities from product and service businesses to digital platforms ecosystems amongst manufacturing industries in Finland. Their main interest was to study digital platforms composed by several companies bringing together their expertise to produce new business, and what hinders these coalitions. They conclude that the lack of boundaries resources is the primary obstacle in the development of the multi-company platforms. *Boundaries resources* mean the co-operative, legal, administrative and operational rules and software tools and interfaces by which the parties interact between each other (Valtioneuvoston Selvitys- ja Tutkimustoiminta 2015). The boundaries resources can be generated by cooperation over organizational boundaries. By using a recent digital platform establishment example from Finland, Kemppi, four strategic questions that need to be considered when establishing platform ecosystems are:

How many sides and parties are taken into the platform?
How to ensure common user experience and different service offerings?
How to define the revenue generation and pricing logics?
How to agree control mechanisms and governance rules?
(Castren, Kortelainen & Seppälä 2016)

Kemppi is a company that offers welding solutions, both products and ready-to-weld services around the world (Kemppi 2017). Though Kemppi has announced 2016 opening their software development interface to app developers to innovate mobile and internet applications using both Kemppi's data and network, Kemppi has not yet determined the revenue generation and pricing logic in the platform ecosystem. Kemppi's platform is currently two-sided consisting of the welding system users and app developers, however if the platform turns out to be successful enough, it might attract also other welding equipment or solutions producers, which would add one more side to the platform. (Castren, Kortelainen & Seppälä 2016) The fundamental question of *what* sides and what kind of user groups are taken into the platform is even more relevant than *how many* they are.

The need for strategic decision making applies to any transformation attempts, and this example indicates again that when establishing a platform ecosystem takes time, the co-operation model is not complete at once and finally the platforms are evolutionary systems; they change over time.

5 Competition and market

There are a lot of both academic or governmental meteorology organizations, that are mostly concentrated in their own area and commercial weather service providers operating globally (Wikipedia 2017). World Bank (2008, xvii) concludes in its regional report that while the forecasting capabilities have significantly improved worldwide during past decades, many national hydrometeorological services (NMHSs) in Europe and Central Asia are in decline resulting missed potential and opportunities, and there are severe issues regarding insufficient IT and numerical modelling capacity, network and telecom capabilities and workforce competences and skills.

CITYZER project aims to gain business impact in both existing and new markets for customers in different industries e.g., public sector, real estate and energy companies, and distributors (CITYZER 2017b). Therefore, the most relevant direct competitors are global weather service providers like The Weather Company, an IBM Business, Foreca and AccuWeather that have service offering globally for various industries in addition to local consumer services. All these three attract also app developers by providing an access to the data, thus they are operating both in traditional product and service business and as a multi-sided platform.

5.1 The Weather Company, an IBM Business

The Weather Company, an IBM Business, is a weather-forecasting information technology company producing weather-driven business solutions for various industries and covers currently over 70 countries. Weather Company was formerly owned by a consortium but was acquired by IBM in 2016. (Weather Company 2017a; Wikipedia 2017)

The Weather company has organized its offering to seven industry solutions: media, aviation, energy, insurance, retail, government and cross-industry. Each solution is tailor-made for the needs of the particular industry. For instance, the solution for media provides tools for visualized storm forecasts and traffic reports combined with weather data or on-air landscape visualizations using city models, maps and astronomical effects. The modules can be combined and the customers can create their unique, customized forecast and deliver that to audience using broadcast production tools. The solution for energy traders instead utilizes historical data, long-range outlooks and reliable forecasts to help and improve the decision making regarding energy trading. The weather alert solution for government is targeted for improved co-operation and collaboration in case of natural dis-

asters, emergencies and incidents. The solution is integrated with IBM's Intelligent Operations Centers (IOC) for Emergency Management that allows combining historical and sensor data from various sources with the weather data and applying analytics and data visualization. The solution supports local governments and emergency organizations by providing longer range weather forecasts allowing more time for planning and preparation for e.g. hurricanes, on-time storm tracking and scenario planning capability. (The Weather Company, an IBM business 2017b)

Weather caused business losses are over half a trillion dollars yearly and most companies are still reactive rather than proactive towards weather impacts. However, innovative companies in variety of industries are now searching for solutions for better decision-making and business outcomes, such as 1) avoiding and minimizing weather related damages thus improving customer satisfaction, 2) improving demand predictions and optimizing staffing and product placement and 3) providing more accurate forecasts that improve safety of citizens. (Sheridan 7 March 2017)

For aviation industry that is fragile with many dangers, the most recent, up-to-date information and predictive and proactive capabilities are essential. The Weather Company's solution for airlines and airports utilizes data science and analytics to the massive amount of big data aviation constantly produces, which can result big savings by improved predictions and reduced amount of airport delays. (Plante 6 February 2017)

The weather alerting for citizens takes most often place by using news, social or Wi-Fi channels. However, there are regions in the world suffering from congested networks and limited bandwidth that slows down the communication and alerting to prevent disasters. IBM and The Weather Company provide a Mesh Network Alerting system that uses smartphones to connect to each other instead through a cell tower to spread life-saving information. The weather warnings can be passed from mobile device to another that helps to reach as many people as quickly as possible. This technology is designed especially for emerging markets that often suffer poor bandwidth and connectivity and was launched first in India, and is now available in total over forty countries in Asia, Africa and Latin America. (Kannan 30 March 2017)

5.2 Foreca

Foreca is a Finnish company having offices in Helsinki, Stockholm and Moscow and producing digital weather data services in more than 30 languages worldwide. Foreca provides a wide range of services from ready-made graphical weather solutions to interfaces

to access the raw data that support mobile applications. Foreca is one of the most accurate weather forecast provider and one of its key competence and special expertise is the long-term forecasting (over 5 days). Foreca's consumer services are mostly free of charge and cover weather forecast website and mobile-optimized website, weather information box that can be embedded to websites (Forecabox) and mobile applications that can be downloaded for iPhone and iPad, Android and Windows phones and tablets. (Foreca 2017a; Foreca 2017b; Foreca 2017c)

Foreca's services for business are grouped to media, industry, services and data. The services for industry are: road maintenance, wind power, solar power, energy services, marine services, building automation, agriculture and sports. The services for industry use are delivered via username and password protected Extranet service or as raw data feed integration to a target system. The road maintenance service is also available in mobile phones. The weather data is provided in formats of maps, radar animations, point forecasts and weather parameters such as temperature, dew point, precipitation and relative humidity and historical statistics can be saved in an archive. Foreca provides meteorological and climatological research and consulting services, and training courses for its clients to increase understanding of the weather phenomena and weather as a business opportunity or operational saving potential. (Foreca 2017d; Foreca 2017e; Foreca 2017f)

Foreca provides direct access to its data by several API's for different purposes, e.g. NameFeed for location based data and a coordinate based NaviFeed Weather API is for high volume usage for mobile applications, weather portals and interactive weather services and professional use. The technical solutions for Foreca APIS are solid and customizable. (Foreca 2017g)

5.3 AccuWeather

AccuWeather is the world's largest and fastest growing weather media company providing globally hour-to-hour and minute-to-minute free weather forecasting services via its internet services and mobile applications to over 1,5 billion mobile and smart devices users every day. In addition to consumer services, AccuWeather produces a wide range of enterprise solutions to media, business, governance and institutions. (AccuWeather 2017a) AccuWeather APIs is the developer access to the API endpoints that provide daily and hourly forecasts, location, current weather and air quality data. AccuWeather APIs are separately priced and the data specifications and support is available for the developers in the web pages. (AccuWeather 2017b)

6 Research methods

6.1 Desk study

To meet the research objectives to form a theoretical understanding of how platform ecosystems work and evaluate if CITYZER could become a platform ecosystem, and to gain understanding on the research topic, industry and market segments, required an extensive desk study using secondary data sources:

- Earlier researches
- Literature, news and internet publications
- CITYZER project documentation

The desk study started right after the topic of the thesis was chosen and continued throughout the research process in parallel with the interviews and continued after those.

6.2 Interviews

The use case data was collected in Finland by using semi-structured interviews using a set of pre-defined, open-ended questions (Appendix 2) allowing the interviewees also to express their thoughts outside the questions. Interview was selected as a qualitative research method as it is easy to arrange, inexpensive way to collect un-organized and versatile information of a certain topic or phenomena.

Conducting qualitative research interviews however requires from the interviewer careful planning and preparation and use of various skills, such as intensive listening and note taking. When interview is used as a research technique, the researcher needs to develop as much as possible expertise in the topic so that good quality, informed questions can be asked. (Sandy & Dumay 2011, 239) In this thesis the theoretical part (literature, earlier researches, project material and documentation) supports this need to gain expertise and understanding on the research topic and additionally the interviewer had an opportunity to meet the project team in a workshop and ask further information and guidance whenever necessary.

Semi-structured interview technique sets in between two extreme interview types: structured, where the questions are strictly predefined to collect large amount of data and analysing the answers might take less time and unstructured interview in which the questions and direction can change and evolve during the interview. Semi-structured interview is a popular technique due to its flexibility and it allows the interviewer to change the order of questions or wording based on the situation. (Sandy & Dumay 2011, 244-246)

Altogether five use case interviews took place in April-May 2017 in the premises of interviewees and one-on-one, except one interview where there were two interviewees. Two of the interviews concerned property maintenance industry, two sea port operations and one cargo handling solutions. In addition to the use case interview, one subject matter expert in data analytics and start-up business was interviewed in March, similarly with semi-structured approach (Appendix 3). Each interview took 50-90 minutes.

The interviewees had an opportunity to review the use case descriptions and other references to information they had provided and comment if they wanted the information to be presented anonymously in the thesis. Two interviewees did not give a permission to use their name or the company information in the public version of the thesis, thus those parts including use cases are hidden from the published version.

In addition to interviews, CITYZER project data was captured also in meetings and e-mail discussions with project members and in a project workshop in March 2017. CITYZER was also one of the three challenges presented in UXHel17 Design Hackathon which was a three-day event in June 2017 to innovate new solutions for future smart cities. The event provided an opportunity to observe how service design approach works and convinced that it would fit well for innovating new uses for CITYZER.

6.3 Data Collection

The notes on the interview answers and the whole conversation were taken in writing and documented in descriptive format right after the interview. Voice Recording and transcription was not used due to the nature of the interviews – part of the information came up in informal discussion e.g. when going around the company premises - and the volume of the information as each interview took about an hour. The most suitable way to describe and present the data collected from the interviews for the project, was to write narrative use case descriptions.

A use case is a software and system modelling technique that defines the features to be implemented and describes how a user uses a system to accomplish a goal or activity. Use cases define interactions between the system and the actors to accomplish the tasks or goals. Use cases are composed of three basic elements: 1) the actors that are the users that interact with the system, 2) the system, which functional requirements for the aimed behaviour are captured in the use case and 3) the goals that are to be fulfilled by the activities and variants involved. Use cases are documented using unified modelling

language and represented by using standard formats like ovals, boxes and lines between. (Techopedia 2017) The use cases can also be produced in textual format describing the same elements and in their interactions in a written format.

CITYZER project has collected potential use cases from potential market areas in Brazil and China using interviews. The use cases are documented in an agreed format using a specific template and evaluated by the project group. (CITYZER, 2017d) Use cases collected in this research are added to the use case repository of the CITYZER project and validated by the project steering group. Additionally, the only currently (May 2017) approved use case is also transformed to the same template and documented in this thesis to ensure that the knowledge is kept in similar format in one place.

6.3.1 Use case interviews in Finland

The use cases in Finland were collected as part of this thesis by interviewing individuals from companies whose businesses are largely dependent on or impacted by weather conditions. The interviews were carried out as semi-structured, open-ended interviews in April-May 2017. A semi-structured, open-ended interview with predefined questions was the most suitable way to collect the qualitative information from the businesspeople. The aim of the interviews was two-fold: first, identifying potential new use for CITYZER in different market segments i.e. industries in Finland, where the CITYZER demo will be piloted, and secondly to get information about the platform related requirements.

6.3.2 Palmia

Palmia is a service company owned by Helsinki city and provides real estate, property maintenance, transportation, catering and canteens, security and safety and cleaning services in Helsinki metropolitan area employing approx. 1500 employees working in over 1000 locations. Palmia's primary customers are in public sector but it provides services also for e.g. cultural events and business parks and is a partner for Helsinki Opera. For real estate customers Palmia targets to produce cost efficient, sustainable and ecological services using latest technologies and the services can be customized based on customer needs. (Palmia 2017a; Palmia 2017b; Palmia 2017c; Palmia 2017d) Palmia was selected as use case interviewee as it represents a variety of services that might be impacted by weather and traffic conditions due to weather.

6.3.3 Kalmar, Cargotec

Kalmar belongs to Cargotec group and it provides cargo handling solutions to ports, terminals, distribution centres and heavy industry and is world's leader in terminal automation and energy-efficient container handling. Kalmar has more than 5700 employees in 30 countries around the world. Kalmar's offering consists of ship-to-shore and yard cranes, carriers, reach-stackers, empty container handlers, terminal tractors, forklift trucks, spreaders and bulk handling systems. Kalmar provides also terminal automation and integration solutions, and terminal operating systems. One in four containers globally moves using Kalmar solutions. (Kalmar 2017a; 2017b)

According Kalmar (2017c) the industry trends are e.g.: increasing number of containers and sea transportations accompanied by tightened environmental and security regulations will change the global trading, bigger vessels for enlarged loads, sustainable development has become an essential part of ports and cargo industry and automation will play important role in meeting the industry requirements in the future. Kalmar targets to meet the tightened regulations and requirements using automated solutions and provide added value for its customers by offering terminal operating and logistics systems as a service combined with related devices and solutions. Kalmar was selected as use case interviewee as it represents industry that is both directly and indirectly impacted by weather conditions.

6.3.4 Finnsteve

Finnlines Group is a shipping operator that offers ro-ro and passenger freight-vessel services in Baltic Sea and North Sea and port operation services in Vuosaari and Turku (Finnlines 2017). Finnsteve-companies are part of Finnlines Group and it is the biggest port operator in Vuosaari Port in Helsinki and Turku Port providing loading, discharging and forwarding, field operations and warehousing services for vessels and is specialized in unitised cargo traffic (Finnsteve 2017). Unitised cargo type concerns mostly manufactured products and goods and means cargo that is packed together in 'units' before transportation and as cargo type it can include containers and other forms of transportation such as pallets, closed wagons, trucks and goods trailers. All cargo types have their special qualities and requirements and unitised cargo needs to be treated differently than e.g. gas or free-flowing cargo like grain. (Maritime Industry Foundation 2017) A stack of containers is illustrated in Figure 11. Finnsteve was selected to use case interviews as it provides port operation services for cargo vessels in two big ports, Helsinki and Turku.

Figure 10 Stack of Containers (Finnsteve 2017)

6.3.5 Company X

Company X, a Facility Services Company. Interview (confidential) is in Appendix 6.

6.3.6 Company Y

Company Y, an Export, Container and Transit port. Interview (confidential) is in Appendix 7.

6.3.7 Remarks from the interviews

All interviewees expressed general interest in the project, saw its potential and were willing to be available later for the demo testing or contacted by the project for further information. Kouhia and Yli-Paunu (13 April 2017) emphasized that in logistics and terminal services business the chains of product and service providers are long and complex and finding the right organization having the business case and interest enough in investing to new technologies like CITYZER plays a key role. In addition to that they saw that the CITYZER potential is in its capability to provide “AI (artificial intelligence) like computing or modelling capability” that can be integrated to company’s existing systems and/or data to produce new business capabilities, improved value to the customers or cost saving opportunities.

Palmia uses already a service provided by Finnish Meteorological Institute (FMI) and Destia consisting of extranet web-service and SMS alerting to the Palmia's own on-call center. The service has replaced the need for having an own weather monitoring and on-call arrangement in Palmia. (Möttönen 25 April 207). Destia is formerly government owned, nowadays privately managed infrastructure company specialized in building and serving roads, railways and industry environments. Destia is the leader in producing roads and traffic related digital monitoring information, such as automatic traffic counts and digital photography of the road network. (Destia 2017) Thus Destia can complement the weather forecast information with roads observation data and these two sources of information produce more value to Palmia as a customer.

Palmia's feedback on the current service was that the service in general meets the current needs for property maintenance service and especially the virtual meteorologist in the web service was appreciated. Using the forecasts and especially the information about rapid weather changes also for other technical on-call services in Palmia will be considered. (Möttönen May 5 2017)

In addition to winter weather and conditions related resource planning, Möttönen (25 April 2017) brought up an interest in using sensor technology in a broader context, for instance indicating the need for lawnmower when the grass has grown long enough or measuring the snow or water level in the roofs. He also foresees that weather data integration to building automation system could develop new opportunities in property maintenance business, as part of *smart building* concepts. Air quality inside buildings plays a significant role in building management however inside air quality is out of CITYZER scope.

7 Use cases

The interview notes were first written in narrative form and later the information was transformed in a standard format of use case. The use case template was tailor-made for this purpose, based on one hand on the CITYZER use case template that was used in China and Brazil and secondly on the current needs of the project. The use case descriptions were kept in rather high level demonstrating the innovation, business need and value instead of specific flow of actions in the system.

All interviewees emphasized in many ways that the accuracy, reliability and locality of the information are the highest priority for weather services. Weather forecasting models' horizontal capability is approx. 10 kilometres; thus, those alone cannot meet the needs for very local forecasts. Using the radar observation data as CITYZER plans to do, the location accuracy will increase significantly, to approx. 100 meters that will improve a lot e.g. rain and snow nowcasting and very-short range forecasting. (Nousiainen 2 May 2017)

7.1 Use case 1

Use case 1 is based on the needs of Property Maintenance Business and it describes 1) the business potential and use of weather related data integrated to building automation system and b) better prediction and automation of services by using sensor technologies.

Table 1 Use case 1

Use Case 1	
Industry	Property Maintenance Business
Business Circumstances	The works in property maintenance business are seasonal: e.g. gardening, lawnmower and raking the leaves, snow ploughing and preventing slipperiness are seasonal works impacted by weather conditions. Event arrangements, like open-air concerts, city festivals etc. is a service where safety and enjoyment of visitors is much influenced by the weather. Property Maintenance inside buildings concerns many services: security and guarding, cleaning, lightning, heating and air-conditioning and so on. In large buildings, the maintenance costs can be high and for instance automating and optimizing the use of electricity could bring significant cost savings. Smart buildings and Internet of Buildings (IoB) will become reality along the era of Internet of Things (IoT).
Use Description	Using weather forecast data for in-premises services in property maintenance business. Using weather forecasts to optimize the heating and air-conditioning automatically would be convenient for the users and improve cost efficiency. If the

	weather is changing to cold or hot, the system would start adjusting the temperature in advance, to prevent peaks in heating or cooling the premises. The weather-related data could be also used for forecasting the cleaning needs. In schools, day care and alike premises, cleaning is one of the most resource-intensive services and if a lot of dirt is expected due to rain or snow, improved resource planning could bring benefits for the business and increase customer satisfaction. In buildings having a flat roof, there's a special risk for water damages after a heavy or continuous rain, if the water removal systems from the roof are not working correctly. Sensor technology could be used there to observe the water level and humidity in the roof and alert if the water doesn't get away from the roof as planned. This mechanism could prevent water caused damages for the building.
User(s)	Managers of the services (responsible for workforce planning) The users of building automation systems
Value/benefit for the user	For the managers and workforce, improved resource planning means better management of the work For the users of the services, better planning and preparedness can mean improved service levels and convenience
Value/benefit for the business	Reduce the costs of the delays by improved planning and being better prepared for the weather impacts Cost saving and efficiency in energy consumption due to automation and optimization Improve resource and operations planning Improve reliability and customer satisfaction Reduce the risks and costs for damages/accidents in events
Market potential/Market segments	Property Maintenance Services Event Arrangement Services
Current solution	A web-based service provided jointly by Finnish Meteorological Institute and Destia.
Requirements for the technology/solution	Standard data integrations to use the data and combine with data from other sources. Alerts and warnings for fast changes or extreme weather. Mobile enabled service for smart phones and tablets.

7.2 Use case 2

Use case 2 describes the use of weather data in Terminals and Logistics centres. The information was captured from the interview in Kalmar which produces terminal equipment (e.g. cranes, lifts, trucks, vehicles) and terminal operation systems to ports all around the world and in this role, they know the terminal operations well, however it is their customers

who are facing the day-to-day weather conditions in their business, not Kalmar itself (Kouhia & Yli-Paunu 13 April 2017).

Table 2 Use case 2

Use Case 2	
Industry	Logistics Centres and Terminal Services (in ports and railways)
Business Circumstances	Logistic centres and Terminal Services for railway and ship cargo are directly impacted by weather conditions. The terminal areas are wide and exposed by rain, snow, wind, thunder and lighting, temperature changes and other weather phenomena. Terminal operations are tightly scheduled and delays cause easily a snowball effect impacting other service providers and customers.
Use Description	Better preparedness for rapid changes in the weather impacting friction (e.g. freezing drizzle) or visibility (e.g. fog and haze) and wind conditions (volume, speed and direction) that might harm the vehicles and equipment or slow down operations. The forecast model could be combined to a) the terminal operation services to improve the operation planning and b) the terminal vehicles, cranes and other machines.
User(s)	Terminal Operation Services, The Command Center Logistics Operators
Value/benefit for the user	More automation providing more accurate forecasts and resource planning.
Value/benefit for the business	Reduce the risks and costs for terminal workforce accidents Reduce costs due to damages caused to the cargo and containers and any vehicles and machines in the terminal area Reduce the costs of the delays by improved planning and being better prepared for the weather impacts Improve resource and operations planning Improve reliability and customer satisfaction
Market potential/Market segments	Terminal Services Logistics Centres
Current solution	Certain type of cranes and vehicles have observation systems that automatically adjust the speed when e.g. wind gets harder. Many terminal operations are automated, however much of the monitoring is still manual and based on human observations and experienced individuals. Supposedly both global and local weather services are in use, based on what is available in the certain location.

Requirements for the technology/solution	Standard data integrations to use the data and combine with data from other sources. Analytics and fact-based data solutions would be welcome in the logistics industry. Alerts and warnings for fast changes or extreme weather.

7.3 Use case 3

Use case 3 describes a two-fold need for improved alerting regarding changes in weather, especially concerning wind speed and direction, and winter conditions that cause slipperiness thus danger for employee safety in the sea port area. The solution would meet the need to increase the time for preventative and preparative actions and improve the employee and superior awareness and carefulness when the conditions in the area are dangerous. The up-to-date alerts that would get the attention and increase the employee awareness about risky conditions would complement Finnsteve's already ongoing activities regarding employee safety and action plan to reduce accidents at work (Juuti 26 May 2017).

Table 3 Use case 3

Use Case 3	
Industry	Seaport Operations, Container Cargo Services
Business Circumstances	Container Cargo operations are relatively weather tolerant and the yearly material damages are only caused by hard wind. Hard wind can harm especially empty container piles and the preventive action is to lower the piles, however the risk of damages is currently manageable and yearly losses are in acceptable level. Instead, the volume of human accidents caused by winter conditions, especially slipperiness, resulting often long sick leaves is high and has serious impact to both workforce resource planning and costs. The cargo handling is mostly managed from the crane and vehicle cabins however some tasks require the employee to step outside to the slippery surfaces. Most of the accidents happen at this very point.
Use Description	The operating environment would benefit from weather alerting service that would warn about weather changes by predefined rules and forecast model. The wind alerts would warn about significant changes in the wind speed or direction early enough (9-12 hours) allowing time for preventive actions and changes in the planned operations.

	The warnings about icy surfaces and slipperiness for the employees would be delivered to mobile devices (SMS or app) and broadcasted in the operating centre info screen.
User(s)	The weather service can be available for all employees, the alerts could be targeted to specified groups
Value/benefit for the user	The information would be delivered in easy manner without searching. The alerts increase the awareness and remind about being careful under dangerous circumstances.
Value/benefit for the business	Decrease the number of material damages Improve the employee safety Decrease the number of sick leaves that lead to extra costs
Market potential/Market segments	Cargo Services Port operations
Current solution	Freely available web-service without any additional features
Requirements for the technology/solution	Easy to use, pre-defined, customizable alerts that can be delivered to mobile devices and broadcasted in info screens.

7.4 Use case 4

Use case 4 is the first and currently (June 2017) only approved use case for CITYZER. It describes the use for public, i.e. citizens and visitors of a city or region. The use case assumes that the city authorities are the ones to provide this service to help the inhabitants (and visitors) to plan their outdoor activities according up-to-date, local and accurate weather forecasts and air quality information (Utela 2017). The service could be used with mobile devices and presented in displays and screens in public places all over the city. In addition to Use Case 4, there are a couple of identified use cases under project steering group's review and approval.

Table 4 Use case 4

Use Case 4	
Industry	City Authorities Public, The Citizens & Visitors
Business Circum-stances	Weather impacts the lives of citizens in many ways: decisions if the weather will be safe/suitable for outdoor activity are made every day. Many sports and other hobbies are im-pacted or dependent on weather. In cities where pollution and air quality cause problems, people might also want to sched-ule or postpone their activities to avoid health issues. A browser-based application where a user can see continu-ously up-to-date weather and air quality measurements and their short-term forecasts with a high resolution on a city GIS map based on open source technologies. Possibility to define a spot or a route and get the weather and AQ forecast for that spot or along the route via the web user interface. The application shall focus on informing the end user about poor AQ conditions and heavy rain or storm events.
Use Description	Easy to use weather and air quality information (e.g. with mo-bile devices). The service is most likely to be provided by city authorities to the citizens, to encourage outdoor recreation. A browser-based application would focus on weather changes like heavy rain and alerting the user about bad air quality. It would provide the user a continuous information on weather and air quality with a high resolution on a city GIS map based on open source technologies. The user could see the weather on a certain spot or a route.
User(s)	Citizens
Value/benefit for the user	Accurate, up-to-date and reliable forecasts that can be used for planning the outdoor activities.
Value/benefit for the business	The customers would be cities interested in providing addi-tional services to their inhabitants. In the long run the solution could help the citizens to stay health in polluted cities.
Market potential/Market segments	City Authorities
Current solution	Local or global weather forecasting services
Requirements for the technology/solution	Mobile optimized web-pages or mobile application for smart phones and tablets.

7.5 Use case 5 (confidential)

Use case 5 (confidential) is in Appendix 8.

7.6 Use case 6 (confidential)

Use case 6 (confidential) is in Appendix 9.

8 Results and analysis

The objectives of this research were to form a theoretical understanding of how platform ecosystems work, gather information about potential use for weather and air quality data by collecting use cases from relevant industry segments in Finland and evaluate if CITYZER could become a platform ecosystem and what kind of platform ecosystem. The objectives were set together with CITYZER project and the target was to produce information for further use in the project.

8.1 Platforms and business models

As explained in Chapter 4.1, platform business differs from traditional product and service business in many ways and one critical success factor is the ability to orchestrate rather than manage the ecosystem. Skilled people are required to orchestrate the platform architecture, market potential, pricing model and multisided user groups.

Two most powerful phenomena of platform ecosystems; 1) the multisidedness that attract distinct user groups and 2) the network effects, that are explained in Chapter 3.3 apply efficiently to consumer business as they both require and are accelerated by big user volumes, consumer trends and benefit from social networks and communities. App development utilizing open data interfaces works best when the operating system the applications will be used in is known and standard, as is for instance with iOS or Facebook.

However, in business-to-business services and applications these two might not work as in consumer markets. Business applications might require a lot of customization and might be integrated to the companies' core systems, such as ERP or other in-house systems, thus the app development is not that straightforward as to standard operating systems. This might limit the interest for the developers' interest and capability to produce business applications.

Business applications differ from consumer applications in several ways: 1) business users typically are forced to use the applications that the organization provides or has chosen to use, and they can rarely make individual decisions regarding applications they would like to use at work, 2) most business apps produce value by using data about the company processes, customers, products and alike information, potentially combined with external data, whereas consumer applications produce value by using data about the individual user potentially combined with external data, 3) business customers are likely to pay for the solution as they are acquiring only services that have calculated business case

either to make more revenue or avoid costs, instead consumers today very likely use the free or cheapest and good-enough app available, 4) consumers can easily abandon the apps that are not satisfying their needs while business users in most cases do not have this opportunity, 5) business applications are not spread as efficiently via people's personal networks and social media similarly as consumer applications because industries have different and specific needs.

These differences need to be considered when thinking about the business model for CITYZER and if it can succeed as a platform ecosystem; getting benefits from network effects amongst user group can be challenging in business-to-business. One option could be to separate the consumer business and business-to-business and have two ways to make business in parallel, which would allow taking the advantage of the platform in developing both businesses but branding, operating and pricing those separately, like many competitors do.

For further discussions on the CITYZER business model it is important to acknowledge that for most businesses weather is only one factor amongst countless of factors in the industry. All interviewed organizations brought up the need to consider the risk vs. the costs and/or potential business benefit to determine how much value a new solution would bring to the company. If the risk of and current amount of weather related damages is in manageable level or the new business opportunities are not clear enough, there is little interest to investments.

Especially in the sea port industry there are typically several operators working in the same area, taking part in the processes or otherwise dependent or impacted by each other. The relationships between these service providers are not hierarchical which means that many operators in the port might see the need for improved weather services or would benefit from such, however it is difficult to identify the one who would have the interest and business case for arranging the service for the whole area and chain of service providers.

Additionally, it is good to understand that CITYZER is not a generic operating system on top of which a wide variety of apps could be built but instead it targets to serve the specific need and purpose for intelligent use of weather and air quality data and forecasts of those, ideally providing business opportunities. Therefore, comparing CITYZER as such for instance to iOS or Android is needless.

Mobility; meaning using mobile applications in any mobile device at work, is not a priority but more like an add-on for the interviewed organizations as the operations are still built around command centres (an own one or service provider's) or the workforce is working in a specific location (ports). Though the processes, equipment and vehicles in the interviewed industries have evolved significantly thanks to automation and use of technologies, they are still in many ways conventional and the roots are in traditional, manual work. Thus, the changes from 'current' to use of future technologies needs special attention and change management and will not happen overnight. However, all interviewees expected that the weather service would be at least capable for mobile use and none of them was against the use of mobile application at work.

The way of producing and managing information technology solutions in the organization most probably influences the decision making of the investments and willingness to take part in the service development. Some of the interviewed organizations acquire most of the IT services from service providers, some have an own internal department or other internal resourcing for that or the services are managed elsewhere in the parent company.

If some customer organization would want to integrate CITYZER data for instance with their ERP system or other business processes to produce analytics, business forecasts or simulations, the circumstances, existing technologies and internal knowledge in the customer company play a significant role in identifying the solution requirements and specifications how to utilize the data.

The aim for the whole CITYZER project is to find business opportunities and create new digital services and products. CITYZER potential value for different user groups consists of layers as described in the Chapter 2.4. It is necessary to identify the customers, the user groups who are willing to pay for the service i.e. generate the revenue. The paying customers could be for instance:

- Software companies that would use the access to CITYZER data and forecast models and develop services which would integrate the data with other technologies like ERP systems to produce new business applications for the markets.
- Direct business customers or authorities that would themselves have the necessary resources, knowledge and technologies to use CITYZER data and forecasts in their business systems.
- Direct business customers or authorities that would buy the whole solution from CITYZER without any external layer in between.
- App developers; the freelancers and enthusiasts that would use the access to the data to produce mobile apps for consumer users.
- Consumers directly, if CITYZER consortium continues the app development themselves.

If CITYZER wants to attract app developers there needs to be an opportunity to make money with the apps. It is unlikely that consumer users would be willing to pay for such weather services they can get elsewhere free of charge; and today plenty of services are. However, consumers could be interested in paying a small installation fee for a mobile app that would provide new features, like combining weather and air quality data with e.g. a work out app or traffic forecast.

For the mobile app developers, even better option is to get in to a situation where users make continuously in-app purchases (new features, more storage etc.) to gain more benefit from the app. In 2016 only 5% of users made in-app purchases but they produced 20 times more revenue than the rest of the users who paid only about the download (Kearl 28 July 2016).

To attract consumer users getting full benefit from platform network effect, CITYZER could find ways to design two-way interaction with the users. This could mean allowing users to also input data into the platform system to add the value for all users, and not only to consume it. For instance, users could manually add their observations to the system or a sensor could be installed in some device they carry (e.g. mobile device, sports tracker/GPS-watch) feeding the data about the weather and air quality automatically.

When considering the business model, it is important not to fall into the pitfall that establishing a platform ecosystem would be an easier way to get to the market, than the conventional product or service production. As described in Chapter 3.1, the platform architecture is a mix of well-defined stable and variable components that are designed for different purposes. For instance, building the interfaces which stand the test of time, plays an essential role.

The platform user groups, such as app developers, need to be able to know and trust the components they use for the integrations and interactions with and within the platform ecosystem. When heading into platform business, it is equally important to gain the users interest, trust and will to use the platform as it is in consumer business or business-to-business. The customerships are just different.

Harri (9 June 2017) stated in UXHelsinki 2017 Design Hackaton, that “CITYZER develops an integrated open business ecosystem for providing localized weather-related services with high spatio-temporal resolution in urban areas”. This means that CITYZER needs to build the business model from this perspective and determine whether it wants to become

solely an open data provider for others to make business or does it target to do business i.e. revenue with the platform as well.

8.2 Use cases and potential customer segments

The use case descriptions as such are a valuable research result from the interviews providing a real voice of a customer from the selected industries for the project to work further.

In the interviewed industries, the air quality data seem to have no or little relevance or the impact is un-known, thus the results and analysis are focused in weather-related services. Partly the reason for this is that the interviews took place in Finland where the air quality issues play not as important role as the weather conditions. Identifying and interviewing the potential market segments for the air quality data could be a relevant topic for further researches.

The interviewees in general are quite satisfied to the current weather service they are using though they could suggest some minor improvements. As introduced in the Chapter 5, there are already several weather service providers in the market that offer mostly free-of-charge consumer weather services, standard and customizable business solutions for various industries and data interfaces for app developers. To CITYZER this means that it needs to differentiate from the competitors by providing a unique, value adding or significantly more accurate or local service to get customers as a change from the current service into a new one needs to be rational and provide a better solution or cost savings.

Based on the experiences from the interviews for this research, there is motivation and interest to take part in the project, solution innovations and demo testing in the potential industries, thus CITYZER partners could benefit from their networks and use those to gather market understanding. From CITYZER partners, FMI already produces business-to-business weather forecasting services, also in alliance with Destia, as described in Chapter 6.3.7. It would be beneficial to utilize more the internal experience of producing business solutions and involve the current customers in the CITYZER project.

The interviews in this research represented two industries; port operations & terminal services and property maintenance business. The interviews in this study already proved that the different industries have plenty of special characteristics and underlying needs. Therefore, it could be useful to involve people from organizations like:

- Health Care
- Public Transportation
- Indoor and Outdoor Sports Centres
- Amusement Parks
- Cleaning Services
- Home Delivery Services
- Insurance Companies

as these businesses could very likely to benefit from adjusting their offering, capacity, pricing or resourcing according weather and air quality circumstances. Again, gaining understanding from potential customer segments in early phase is recommended.

Discussions with experts from various organizations and industries provide valuable information about the needs and ideas that are not evident and do not come first to mind. For instance, Use Case 1 describes how weather and air quality data could be used to improve and optimize in-door technologies in premises maintenance business when typically, weather solutions are thought to be produced and consumed outdoors.

8.3 CITYZER platform potential

In the light of this research there are no such things that would prevent CITYZER from becoming a platform ecosystem. However, this research didn't either bring up such knowledge that any model could be the one and only option for CITYZER to make business. Therefore, there is no other recommendation for the project than to be aware and acknowledge the differences, requirements and pros and cons of the business models, and to have a throughout discussion and agreement about that with the CITYZER partners. This is already planned to happen in autumn 2017, using the business model canvas as mentioned in Chapter 4.2.1.

A useful way to consider different options in a consistent and structured manner, is to write the scenarios down in a comparison table. Considerations of three potential and different business models; 1) a conventional service or product provider, 2) a platform owner or 3) a 'hybrid' a mix of those two, are presented in the Table 7. In the table there are pros, cons and other remarks about these three options from CITYZER perspective. It is good to note, that from other user groups: customers', app developers' or consumers' point of view the advantages and disadvantages of each option could be different.

Table 5 Business model comparison

CITYZER Business Model	Pros	Cons	Remarks
Service or Product Provider	Control of the whole value chain Conventional delivery channels Existing customerships can be utilized Straightforward and familiar revenue-cost model Internal research and development accelerates new innovations Development can be done with selected customers (that support commitment to the service) Control of the architecture and design principles and changes in those	Conventional model falls behind from the competitors Requires own and/or acquired resources for innovations and app development Requires sales and marketing efforts, the brand and conspicuousness amongst users might be even more important than the service features Service support needs to be arranged	Producing the first minimum viable product/service plays an important role It is more likely to succeed with traditional model and later transform into a platform, than start with a multisided platform. CITYZER consortium must agree: who is the Service Owner?
Platform Owner	Distributed innovation Risk transfer / sharing Capturing new and unknown market segments Success and volumes attract more volume and more success Marketing happens via social networks, communities and app stores	Success uncertainty The platform and data 'brand' becomes uncontrollable Changes in certain core components are not allowed Setting right price might be challenging and very dependent on the competitor prices Internal interest and commitment on the platform owner role requires education If it is a real open data platform, the opportunities to do business are in the app developers group and it is difficult to find a way to make money for CITYZER	Change in mindset is needed Freedom and openness outwards requires discipline and rules inside Platform design and architecture must be well-thought, logical and sustainable CITYZER consortium must agree: who is the Platform Owner?
Hybrid	Many competitors currently operate in a hybrid model Safer option, as all the most workable services and the business model can be tested in reality	Hard to be unique when many players have same business model Requires double governance and two different mind-sets; might require more resources	Hybrid could be established in many ways: e.g. consumer services could be released to app developers and business solutions

	Supports both internal research and development & distributed innovation	in management thus might generate duplicate costs	kept as services in-house OR CITYZER could be one developer user of the platform amongst other app developers OR CITYZER could act in a solution consultant role between business customers and app developers, and simultaneously provide the open data platform CITYZER consortium would need to agree: how to ensure skills and resources to manage both ends?

8.4 Development ideas

The research work was intensive and brought up some additional ideas and thoughts regarding service innovation and development process, and the topic itself, which is natural when going through a lot of information from wide variety of sources. Some of these ideas are introduced in this chapter.

8.4.1 Using Service Design process in producing new innovations

The interviews proved that there is an interest in new innovations and using weather forecasting as part of business processes, yet those are not in a form of a specific need or requirement but rather early ideas what could be done. This could be a room of opportunity for CITYZER; to facilitate and consult the process of innovating new solutions together with potential customers. This innovation process could be done using Service Design thinking and methods because the idea generation and development for different industries cannot succeed as desk study without user understanding and involvement.

Service Design thinking has taken foothold also in software business in recent years. For instance, IBM has branded their IBM Design Thinking framework that is dedicated on keeping the focus in users from the very beginning and how the human-centric services should be designed (IBM 2017).

Service Design principles are:

- Services should be designed based on a genuine comprehension of the purpose of the service, the demand for the service and the ability of the service provider to deliver that service.
- Services should be designed based on customer needs rather than the internal needs of the business.
- Services should be designed to deliver a unified and efficient system rather than component-by-component which can lead to poor overall service performance.
- Services should be designed based on creating value for users and customers and to be as efficient as possible.
- Services should be designed on the understanding that special events will be treated as common events
- Services should always be designed with input from the users of the service
- Services can and should be prototyped before being developed in full
- Services must be designed in conjunction with a clear business case and model
- Services should be developed as a minimum viable service (MVS) and then deployed. They can then be iterated and improved to add additional value based on user/customer feedback.
- Services should be designed and delivered in collaboration with all relevant stakeholders.

(Interaction Design Foundation 2017)

This list of principles provides a good baseline and checklist for new service development or service improvement activities in any industry. For CITYZER, involving potential customers and users of the services would produce such understanding of the service needs that it could be transformed to demos and prototypes that would help envisioning the innovations and value of those, and getting feedback for further development. Developing and testing the services with selected customers was also a recommended approach by Birkstedt (7 March 2017).

Service Design tools that are used for envisioning allow people to show, externalize and share to others what is in their minds. The tools help in making the ideas visible and understandable for others and often help expressing and explaining unconscious or unclear needs, thoughts and ideas. (Service Design Tools 2017) This would be more useful approach than trying to innovate without user involvement or asking direct questions when the thoughts, needs and ideas are not yet clear as was the case in many use case interviews.

CITYZER was one of the three challenge cases in the UXHel17 Design Hackaton in 9-11 June. The purpose of the event was to gather together design-oriented people to innovate

services and solutions for future smart cities, using the service design process and principles described above. This confirmed that using Service Design thinking and process fits for CITYZER's needs and is a beneficial and suitable way to collect innovations.

8.4.2 Space weather forecasting

FMI publishes already now a weekly auroras and space weather forecast in their internet pages. Space weather concerns phenomena caused by solar wind and solar flares in the near-Earth space and the upper part of the Earth's atmosphere, and FMI provides both information about past 24 hours and the weekly forecast on Mondays. (Finnish Meteorological Institute 2017a, 2017b)

Powerful space storms can cause additional currents on electricity grids and at worst lead to power outages. FMI researches the space storms and models the potential consequences of those especially in Europe area. (Finnish Meteorological Institute 2017c, 2017d)

The scientists forecast that a powerful solar storm like the Carrington event in 1859 would have dramatic consequences to the societies and world economy today as the infrastructure is totally dependent on the electricity, GPS and networks. Most modern technologies, like global communications and data transmission, aircrafts and satellites would be impacted immediately. Therefore, there is increasing interest in the space and solar storm research to gather more information and NASA is launching a new solar probe for this purpose. (Letzter 17 May 2017; Yle Uutiset 31 May 2017)

FMI could consider offering the space weather data as part of CITYZER and identify new business opportunities from industries that are either energy providers or most vulnerable to power outages. In the long run this service could potentially become a unique and value-adding commercial service and a competitive advantage as space weather information is not provided by most competitors.

9 Conclusions

On one hand this research confirmed that there is no one, correct option when choosing a business model for a starting software business but the most important thing is to understand the differences and consequences of the models taking also into account how the competitors have organized their offering. Harri (9 June 2017) stated that CITYZER aims to become an open business ecosystem that others can build upon. This means that the focus need to be in attracting the developer users.

It is not however clear yet if CITYZER only allows others to do business or if it targets to do business with the platform as well and how. CITYZER is currently a project consortium of many partners and will it continue as an alliance after the project and how, plays also an important role when determining the business model. The discussion and work around business model continues in the project during autumn 2017.

On the other hand, the use case interviews proved that involving organizations from potential customer segments representing various industries early in the development phase is a useful approach. The interviews produced a lot of information about the operating environment, current challenges, needs and ideas in regards of weather and air quality in their industries. The business customers expect and value accuracy, reliability and locality in weather forecasting services. Currently the accuracy concerning the probability, timing and location, especially in regards of snowing, is not good enough for decision making and resource planning but a lot of manual observation is still required.

And finally, the interviews also proved that the CITYZER potential is seen in its capability to provide “AI (artificial intelligence) like computing or modelling capability” that could be integrated to other systems and/or data to produce new business capabilities, improved value to the customers or cost saving opportunities.

Listening, observing and understanding the service users by using various methods and sources of information, and later testing the ideas and prototypes in the early development phase are efficient ways to innovate and produce new products and services to the markets. Similarly involving the potential app developers and get their attention and attraction to CITYZER during the project and let them innovate using modern service design thinking around CITYZER data and forecasting models is an excellent approach, as was done in UXHelsinki 2017 Design Hackathon in June 2017.

10 Discussion

This thesis was carried out on request for an ongoing research and development project CITYZER and the purpose was to support the project objectives by collecting potential use cases from various industries and study the applicability of platform ecosystem model to CITYZER. Therefore, the results of this research are meant specifically for the CITYZER project use however, especially the theoretical part considerations about platform ecosystem as a business model, can be applied to software start-up businesses.

For this research, main contacts from the project have been Haaga-Helia Project Managers Tiina Laiho and Pekka Lahti. Jouni Soitinaho, Principal Lecturer in Information Systems Management Master Programme, acted as a supervisor for this thesis. I thank them and all project team members for the supporting my work.

From my personal perspective, doing the thesis was interesting and I learnt a lot about platform ecosystems; how they work and how they differ from product and services businesses, and what are their strengths and challenges when considering the business model for a new or transforming business. This thesis also offered me a window to industries and business opportunities that I was not earlier familiar with at all and I enjoyed a lot doing the desk research and the interviews with the subject matter experts.

I also appreciate this unique opportunity to take part in a research and development project that aims to produce new digital services for global markets using Finnish know-how and technologies and I am confident that this study is useful for the project.

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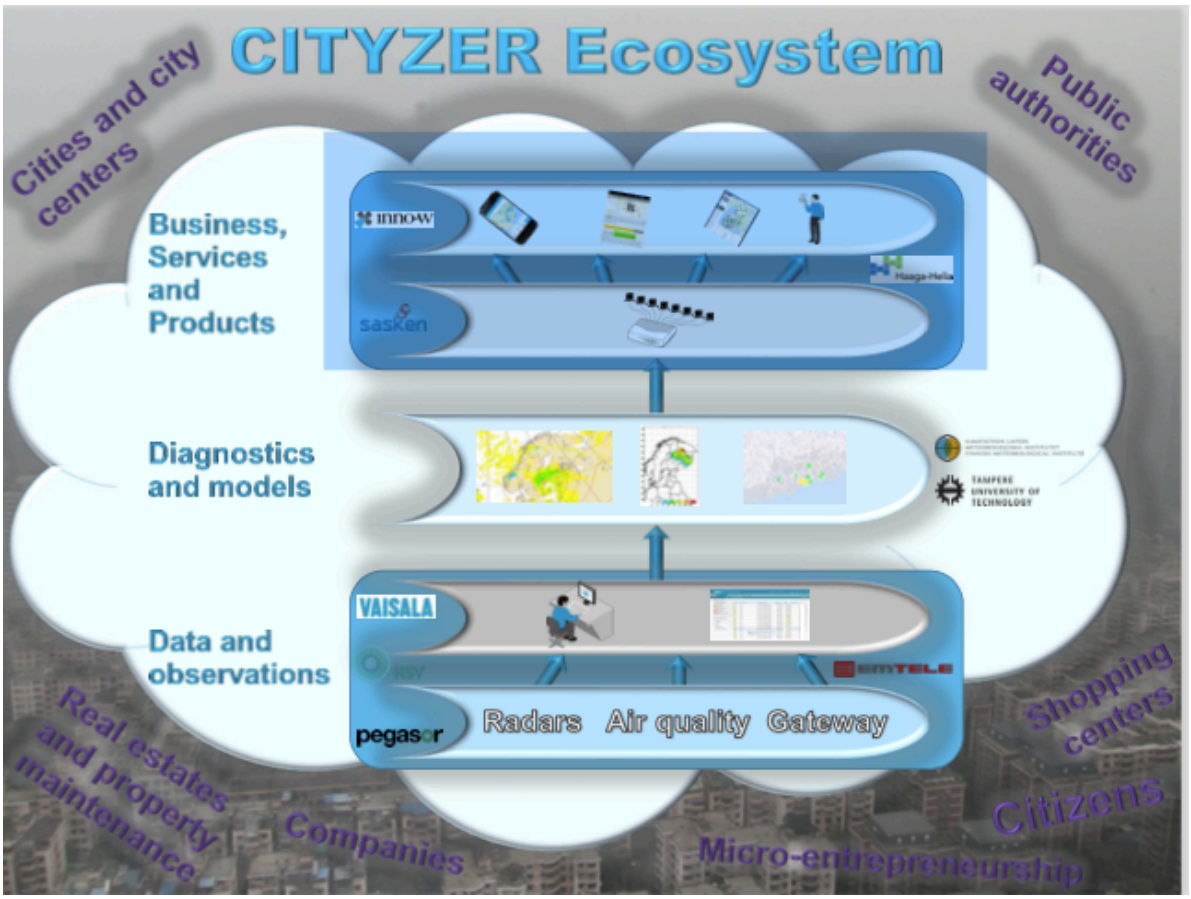
Appendices

Appendix 1. CITYZER ecosystem.

CITYZER ecosystem. CITYZER Project Presentation (Harri, A-M 9 June 2017).



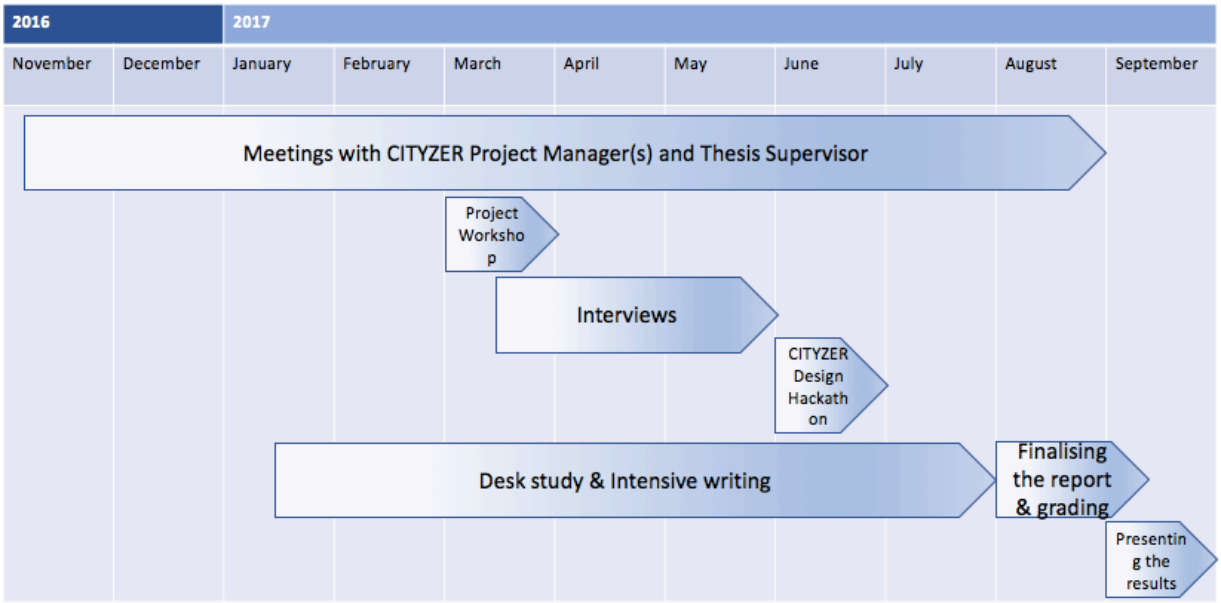
Appendix 2. Use Case Interviews Questions

What are the weather and air quality related problems/challenges that the company is facing with its businesses and business environment?
Losses and damages yearly?
What is the impact of these problems to the business?
What weather/air quality related services the company use and what are the use cases?
What they value in these partnerships?
Is the company possibly looking for new partner or solutions in this area? If so what?
What kind of data the company is getting now and how it is using it?
Do you get enough information relating to weather and air quality?
Examples of well-working use?
What could be improved or what information is still lacking?
How would you like to get this information in the future (when, how, in what format)?
What business benefits/cost saving opportunities they would see in the weather data?
How likely the company would be investing in such service? What kind of services would they expect the service provider to solve the existing problems?
Does the platform in use matter?
I.e. does it have any impact in their interest in CITYZER whether it is a service or if the applications would be developed in a developer community?
Do you want to further analyse the data or share it for further use?
To what kind of IT environment the service would be integrated and does it set any limitations?
Is there a need for mobile application / are there mobile workers?
How much they would be willing to pay for such service?
Would the company like to develop the applications using the weather/air quality data themselves or take part in it?

Appendix 3. Interview Questions for BigDataPump

- What is their view on the CITYZER business model?
- What kind of SWOT they see in the CITYZER?
- Would it be a tempting opportunity for them to be involved in CITYZER?
    - Why/why not?
- What could be the potential co-operation model with CITYZER?
- How is their innovation process?
- How is their service design process?
- Start-up experiences and advices for bringing new innovations/products to markets?

Appendix 4. Thesis schedule and main activities



Appendix 5. Core concepts of Platform Ecosystems

Core Concepts of Platform Ecosystems (Tiwana 2014, 25).

Table 2.1 Core Concepts and Where They Directly Apply in Software Ecosystems

Concept	Relevance			Description
	Platform	App	Ecosystem	
Platform lifecycle	●	●	●	A multifaceted characterization of whether a technology solution—a platform, an app, or the entire ecosystem—is in its pre- or post-dominant design stage; its current stage along the S-curve; and the proportion of the prospective user base that has already adopted it
Dominant design	●	●		A technology solution that implicitly or explicitly becomes the gold standard among competing designs that defines the design attributes that are widely accepted as meeting users' needs
S-curve	●	●	●	A technology's lifecycle that describes its progression from introduction, ascent, maturity, and decline phases
Leapfrogging	●	●	●	Embracing a disruptive technology solution and using it as the foundation for the firm's market offering in lieu of an incumbent solution in the decline phase of its S-curve
Diffusion curve	●	●		A description of whether a technology solution—a platform or an app—is in the stage of having attracted the geeks, early majority, early adopters, late majority, or laggards to its user base
Multisidedness				The need to attract at least two distinct mutually attracted groups (such as app developers and end-users) who can potentially interact more efficiently through a platform than without it
Network effects	●	●		A property of a technology solution where every additional user makes it more valuable to every other user on the same side (same-side network effects) or the other side (cross-side network effects)
Multihoming	●			When a participant on either side participates in more than one platform ecosystem
Tipping	●	●		The point at which a critical mass of adopters makes positive network effects take off
Lock-in	●	●	●	The ways in which a platform can make it more desirable for existing adopters to not jump ship to a rival
Competitive durability	●	●	●	The degree to which the adopters of a technology solution continue to regularly use it long after its initial adoption
Envelopment	●	●		When a platform swallows the market of another platform in an adjacent market by adding its functionality to its existing bundle of functionality
Architecture	●	●		A conceptual blueprint that describes components of a technology solution, what they do, and how they interact
Governance			●	Broadly, *who decides what* in a platform's ecosystem. This encompasses partitioning of decision-making authority between platform owners and app developers, control mechanisms, and pricing and pie-sharing structures

Appendix 6. Interview X (confidential)

Appendix 7. Interview Y (confidential)

Appendix 8. Use case 5 (confidential)

Appendix 9. Use case 6 (confidential)